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A COMPARATIVE STUDY OF THE GRADES OF PUPILS FROM DIFFERENT ELEMENTARY SCHOOLS IN THE SUBJECTS OF THE FIRST YEAR IN HIGH SCHOOL

FRANKLIN W. JOHNSON
Principal of the University High School, Chicago, Illinois

[Editorial Note.—The editors of this *Journal* are the officers of the Elementary School of the University of Chicago. They present with very great satisfaction the following article as a full, concrete illustration of the application of impersonal scientific methods to elementary-school problems. In the near future other studies of larger school systems will be presented, and it is hoped that the significance of this method will be widely recognized. If studies of this type could be made in every school system, supervision and administration of schools would rise to a level never attained in any educational system.

Attention is not unlikely to be drawn to those parts of the report which seem to show defects in the work of the University Elementary School. In later years similar reports will be made, and it is hoped that concrete evidence can then be presented of the advantages of knowing one's own weaker points. This study is the basis of the present administration of the school. The officers of the school are clear also that their problem is not merely to prepare for high school. The Elementary School does many types of work not touched on in this report. The aim of the school, however, is to do the conventional types of work in such a way as to achieve equal efficiency with other schools and at the same time to work out problems not taken up by these other schools.

Finally, the significance of these results will not be fully appreciated by any reader who fails to recognize that the high school is studied by these tables quite as much as the elementary school. Is the relation here discovered in history due to the training in the elementary school or to the methods employed in the high school? The practical answer to this question is to be found in the fact that the history instructors in these two schools have been organized since the preparation of these tables into a single department. They have their problem set before them in impersonal and yet very emphatic form.—The Editors.]

This study was undertaken for the purpose of testing the efficiency of the University Elementary School on the basis of the grades received in the first year of the University High

School. The pupils under consideration entered the High School in the autumn of 1909. The class contained 128 members of whom 44 came from the University Elementary School and 84 from other elementary schools, these being with a few exceptions the public schools of the city of Chicago.

In Diagrams 1–7, representing the grades of the Autumn Quarter, each number represents the same pupil throughout, those from the University Elementary School being indicated by bold-faced type (e.g., **19**), all other pupils by numbers in plain roman (e.g., 30). The numbers were assigned without reference to the schools from which the pupils came in the order in which the names occurred in the class lists of the various classes in English in the Autumn Quarter. The grades in the University High School are reported by teachers in multiples of five, passing grades ranging from 60 to 100. In the diagrams the grades are given at the bottom and the numbers in each column represent the pupils receiving these grades. For the purpose of comparison each diagram is divided into quintiles or groups comprising one-fifth of the class. The method adopted for the division into quintiles places in the lower quintile those pupils at the top of the column necessary to fill out the number. It will be noted that in the diagram for the Autumn Quarter in English this method happens to place an undue number of pupils from the University Elementary School in the two lowest quintiles and removes from the highest quintile to the next lower all the elementary-school pupils who received a grade of 75. The comparative standing in English of the pupils of the University Elementary School for the Autumn Quarter is thus less favorable than it should properly be and the standing in this subject is made somewhat less favorable for the entire year. An equitable redistribution would change the result as indicated in the broken line in Diagram 8. Chance seems to have played no similar part in any other portion of the comparison.

The diagrams are of interest not only because they exhibit the relation of pupils from the Elementary School to others, but also because of the light which they throw on the practices of different departments in the High School. Thus it will be seen at once that the English department differs radically from the Latin Department in its use of the higher marks. The Science Departments distribute their students in a manner altogether different from the English Department.

Furthermore the diagrams make it possible to trace the individual variations of each pupil. Thus pupil number one stands in the highest quintile in English, Latin, Mathematics, and Design, but takes his place in the third quintile in French and German. Pupil number 2 stands in the highest quintile in all subjects which he takes. Number 5 stands well in English, Mathematics, and History, fair in Latin and Design, and far down the scale in Science. Number 102 shows the widest single variation, standing low in all subjects except Mathematics, in which he is one of the three to receive the highest grade.

DIAGRAMS 1–7

UNIVERSITY HIGH SCHOOL

Freshman Class, 128 pupils, *Autumn Quarter*, 1909

DIAGRAM 1.—ENGLISH

				47				
	118	110		**46**				
	117	108		45				
	116	**88**		**44**				
	115	**87**		**43**				
	113	**86**		**42**				
	112	**85**		**41**				
	111	**84**		**40**				
	109	**83**	**65**	**39**				
	107	**82**	**64**	**38**				
	106	81	**63**	**37**				
130	103	**80**	62	**36**				
129	**102**	**79**	61	**35**				
128	**101**	**78**	60	34				
127	**100**	77	59	33				
126	99	76	58	32				
125	98	75	57	30				
124	97	74	56	29	20	**11**		
123	96	73	55	28	**19**	**10**		
122	95	72	54	27	18	**9**		
121	94	71	53	26	17	**8**		
120	93	**70**	52	25	16	7		
119	92	69	51	24	15	5		
114	91	**68**	50	23	14	4		
105	90	67	49	22	13	3		
104	89	66	48	21	12	2	**1**	
Fail.	60	65	70	75	80	85	90	95

128 pupils

1st	Quintile	26
2d	"	26
3d	"	26
4th	"	25
5th	"	25

DIAGRAM 2.—LATIN

101 pupils

1st Quintile		21
2d	"	20
3d	"	20
4th	"	20
5th	"	20

Fail.	60	65	70	75	80	85	90	95
130								
129							**87**	
128						119	81	
125						**100**	**64**	
124			110			95	**40**	
123			109			**86**	**39**	
121			106		**101**	**82**	**38**	
117		120	96	**127**	90	72	**37**	
114	126	**112**	**85**	**116**	**83**	**63**	20	47
99	**118**	**102**	77	**113**	**79**	49	**19**	**44**
84	**115**	97	61	107	62	**46**	18	**42**
66	103	91	59	98	55	**41**	13	12
60	75	**88**	56	53	54	**36**	**11**	**10**
51	73	**78**	50	28	**43**	23	**8**	**9**
48	**65**	30	32	17	**35**	15	7	4
3	58	26	25	14	33	5	**1**	2

DIAGRAM 3.—MATHEMATICS

127 pupils

1st Quintile		26
2d	"	26
3d	"	25
4th	"	25
5th	"	25

Fail.	60	65	70	75	80	85	90	95
				126				
				110				
				103				
				100	**101**			
	128			91	93			
	127			90	71			
	122		**116**	76	**68**			
	113	124	**112**	67	59			
130	109	120	**111**	**63**	45			
129	107	119	95	55	**43**			
125	106	114	**85**	51	**40**			
123	104	108	**83**	48	**39**			
121	97	105	74	**41**	**36**			
117	**88**	94	73	**38**	32			
115	**82**	92	72	**35**	30			
99	**80**	89	61	27	28		**118**	
98	**79**	**78**	58	25	23		**64**	
96	77	62	56	24	15	**87**	53	
81	**70**	57	**37**	22	**11**	**86**	**44**	
75	69	54	18	21	**10**	60	**42**	
65	66	52	16	20	7	**46**	**19**	**102**
34	17	50	14	13	5	33	4	47
29	**9**	49	**8**	12	3	26	**1**	2

DIAGRAM 4.—SCIENCE

84 pupils

1st Quintile		17
2d	"	17
3d	"	17
4th	"	17
5th	"	16

Fail.	60	65	70	75	80	85	90	95
123	**127**	124	**128**	119	**111**	107	103	74
117	125	**113**	**116**	**115**	109	91	95	33
108	105	99	**78**	110	106	**79**	89	22
104	**70**	98	58	96	97	73	71	21
77	69	94	55	59	92	72	32	15
57	**68**	**80**	**38**	56	90	67	23	13
29	**65**	75	27	53	**88**	61	18	7
	54	5		28	66	51	12	4
	49			14	**64**	50		2
	34				52	48		
					26	**10**		
					25			
					17			
					9			
					8			

DIAGRAM 5.—HISTORY

97 pupils

1st Quintile		20
2d	"	20
3d	"	19
4th	"	19
5th	"	19

Fail.	60	65	70	75	80	85	90	95
129	**127**	**116**	110	123	107	59	18	
128	119	106	98	**115**	**64**	30	13	
125	114	92	95	**111**	61	21	12	
124	108	91	**88**	103	56	15	7	
121	104	90	81	76	53	**10**	4	
120	99	**82**	75	74	52	**8**	2	
105	96	**79**	71	60	48	5		
102	**80**	73	67	54	47			
97	**78**	57	66	50	45			
94	77	**38**	**65**	49	**39**			
93	72		58	**44**	33			
70	69		55	**42**	25			
	68		51	26	24			
	32		34	22	23			
			27	17	14			
				16	**9**			
				3				

DIAGRAM 6.—FRENCH AND GERMAN

38 pupils
1st Quintile 8
2d " 8
3d " 8
4th " 7
5th " 7

Fail.	60	65	70	75	80	85	90	95
122 **112** 108 **80**	94 89 22	**118** **102** 24	**111** **101** **100** **85** **83** **68** 62 **42** **1**	74 **70** 67 **63** **41** **36** 20	**87** **43** **40** **39** **35**	76 **46** 45 **11**	**86** **19**	21

DIAGRAM 7.—DESIGN

119 pupils
1st Quintile 24
2d " 24
3d " 24
4th " 24
5th " 23

Fail.	60	65	70	75	80	85	90	95
130 77	**102** **8**	119 **82** 48 **42**	124 123 121 120 105 96 91 89 81 **80** **78** 76 74 66 62 53 49 **44** **41** 32 23 17	129 125 122 109 108 107 106 104 103 99 94 92 **88** **83** **79** **70** 69 **68** **63** 57 50 **43** **38** **36** 34 26 21 **19** 13	**127** **118** **117** **116** **112** 110 **101** 97 95 **64** 60 59 55 **46** **37** 20 18 14 **11** **10** **9** 5	**128** **115** **113** **111** **85** 75 73 **65** 61 58 56 47 45 **40** **35** 22 16 15 12 7 3 **1**	**100** 98 **87** **84** 72 71 51 30 29 28 27 25 4	**86** 33 2

Turning from these considerations to the main problem of comparison it is obvious that if the pupils from the Elementary School were in all respects like those from other schools a certain percentage of them should be distributed through each quintile in each of the subjects. Thus since there are 128 taking English and 44 of them come from the Elementary School, we might expect 34.4 per cent of each quintile to be from the Elementary School. Table I shows in detail how far the facts depart from this expectation. In the first column of figures at the left of Table I is recorded the total registration in each subject. In the second column the number of pupils from the Elementary School is recorded. In the third column is shown the percentage of University Elementary School pupils in each subject; in the other columns appear the percentage of University Elementary School pupils in each quintile and the variations in each subject from the normal or expected percentage. In the first and second quintiles an excess (+) represents an unfavorable showing for the University Elementary School, while a deficiency (—) represents a corresponding favorable showing; in the fourth and fifth quintiles an excess represents a favorable and a deficiency an unfavorable showing.

Tables II, III, and IV set forth similarly the facts for the Winter and Spring Quarters and for the entire year.

The matter can be exhibited graphically on the basis of Table IV by means of Diagrams 8–14. In each of these diagrams the horizonal line marked "0" indicates the level at which the Elementary School representatives should stand. The position which they take in each quintile is shown by the curve which crosses this horizontal line. Thus in Latin the real distribution is below the normal line for the three lowest quintiles and above for the two highest. By way of contrast the History curve is above the normal in the lowest quintile and below in all others.

From Diagrams 8-14 it appears that the pupils of the University Elementary School are greatly superior in Latin, Mathematics, French and German, and Design; in English they are somewhat inferior but stand in large proportion in mediocre

TABLE I

Excess or Deficiency in Grades of University Elementary School Pupils in Each Quintile for the Autumn Quarter

Subject	Number Pupils	Number U. Ele. School Pupils	Percentage U. Ele. School Pupils	1st or Lowest Quintile		2d Quintile		3d Quintile		4th Quintile		5th or Highest Quintile	
				Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal
English	128	44	34.4	34.6	+ 0.2	46.2	+11.8	23.1	−11.3	44.0	+ 9.6	24.0	−10.4
Latin	101	40	39.6	23.8	−15.8	30.0	− 9.6	30.0	− 9.6	55.0	+15.4	60.0	+20.4
Mathematics	127	43	33.9	30.8	− 3.1	26.9	− 7.0	28.0	− 5.9	36.0	+ 2.1	48.0	+14.1
Science	84	19	22.6	29.4	+ 6.8	41.2	+18.6	17.7	− 4.9	23.5	+ 0.9	0.0	−22.6
History	97	22	22.7	25.0	+ 2.3	35.0	+12.3	15.8	− 6.9	21.1	− 1.6	15.8	− 6.9
French and German	38	24	63.2	37.5	−25.7	87.5	+24.3	50.0	−13.2	85.7	+22.5	57.1	− 6.1
Design	119	43	36.1	25.0	−11.1	29.2	− 6.9	50.0	+13.9	54.2	+18.1	21.7	−14.4
Total	694	235	33.9	28.9	− 5.0	37.6	+ 3.7	29.5	− 4.4	42.3	+ 8.4	31.1	− 2.8

TABLE II

EXCESS OR DEFICIENCY IN GRADES OF UNIVERSITY ELEMENTARY SCHOOL PUPILS IN EACH QUINTILE FOR THE WINTER QUARTER

SUBJECT	NUMBER PUPILS	NUMBER U. ELE. SCHOOL PUPILS	PERCENTAGE U. ELE. SCHOOL PUPILS	1ST QUINTILE		2D QUINTILE		3D QUINTILE		4TH QUINTILE		5TH QUINTILE	
				Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal
English	108	42	38.9	50.0	+11.1	45.5	+ 6.6	22.7	−16.2	38.1	− 0.8	38.1	− 0.8
Latin	74	33	44.6	33.3	−11.3	53.3	+ 8.7	26.7	−17.9	60.0	+15.4	50.0	+ 5.4
Mathematics	105	39	37.1	28.6	− 8.5	28.6	− 8.5	42.9	+ 5.8	28.6	− 8.5	57.1	+20.0
Science	75	18	24.0	33.3	+ 9.3	33.3	+ 9.3	13.3	−10.7	26.7	+ 2.7	13.3	−10.7
History	80	19	23.8	43.8	+20.0	12.5	−11.3	25.0	+ 1.2	25.0	+ 1.2	12.5	−11.3
French and German	32	21	65.6	85.7	+20.1	14.3	−51.3	100.0	+34.4	50.0	−15.6	83.3	+17.7
Design	104	43	41.3	23.8	−17.5	42.9	+ 1.6	47.6	+ 6.3	61.9	+20.6	30.0	−11.3
Total	578	215	37.2	38.5	+ 1.3	35.0	− 2.2	34.5	− 2.7	40.9	+ 3.7	37.2	0.0

TABLE III

EXCESS OR DEFICIENCY IN GRADES OF UNIVERSITY ELEMENTARY SCHOOL PUPILS IN EACH QUINTILE FOR THE SPRING QUARTER

SUBJECT	NUMBER PUPILS	NUMBER U. ELE. SCHOOL PUPILS	PERCENTAGE U. ELE. SCHOOL PUPILS	1ST QUINTILE		2D QUINTILE		3D QUINTILE		4TH QUINTILE		5TH QUINTILE	
				Per-centage U. Ele. School Pupils	Variation from Normal	Per-centage U. Ele. School Pupils	Variation from Normal	Per-centage U. Ele. School Pupils	Variation from Normal	Per-centage U. Ele. School Pupils	Variation from Normal	Per-centage U. Ele. School Pupils	Variation from Normal
English	106	42	39.6	50.0	+10.4	28.6	−11.0	33.3	− 6.3	38.1	− 1.5	42.9	+ 3.3
Latin	63	34	53.9	76.9	+23.0	46.2	− 7.7	38.5	−15.4	58.3	+ 4.4	50.0	− 3.9
Mathematics	91	37	40.7	42.1	+ 1.4	33.3	− 7.4	22.2	−18.5	50.0	+ 9.3	55.6	+14.9
Science	66	14	21.2	21.4	+ 0.2	15.4	− 5.8	30.8	+ 9.6	23.1	+ 1.9	15.4	− 5.8
History	71	17	23.9	46.7	+22.8	14.3	− 9.6	28.6	+ 4.7	14.3	− 9.6	14.3	− 9.6
French and German	30	20	66.7	66.7	0.0	50.0	−16.7	66.7	0.0	66.7	0.0	83.3	+16.6
Design	105	41	39.0	19.0	−20.0	28.6	−10.4	52.4	+13.4	33.3	− 5.7	61.9	+22.9
Total	532	205	38.7	42.7	+ 4.0	30.2	− 8.5	36.8	− 1.9	38.1	− 0.6	44.8	+ 6.1

TABLE IV

EXCESS OR DEFICIENCY IN GRADES OF UNIVERSITY ELEMENTARY SCHOOL PUPILS IN EACH QUINTILE FOR THE ENTIRE YEAR

SUBJECT	NUMBER PUPILS	NUMBER U. ELE. SCHOOL PUPILS	PERCENTAGE U. ELE. SCHOOL PUPILS	1ST QUINTILE		2D QUINTILE		3D QUINTILE		4TH QUINTILE		5TH QUINTILE	
				Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal	Percentage U. Ele. School Pupils	Variation from Normal
English	342	128	37.4	44.3	+ 6.9	40.6	+ 3.2	26.1	−11.3	40.3	+ 2.9	34.3	− 3.1
Latin	238	107	45.0	40.8	− 4.2	41.7	− 3.3	31.3	−13.7	57.4	+12.4	54.3	+ 9.3
Mathematics	323	119	36.8	33.3	− 3.5	29.2	− 7.6	31.3	− 5.5	37.5	− 0.7	53.1	+16.3
Science	225	51	22.7	28.3	+ 5.6	31.1	+ 8.4	20.0	− 2.7	24.4	+ 1.7	9.1	−13.6
History	248	58	23.4	37.3	+13.9	22.2	− 1.2	22.4	− 1.0	20.4	− 3.0	14.3	− 9.1
French and German	100	65	65.0	61.9	− 3.1	52.4	−12.6	70.0	+ 5.0	68.4	+ 3.4	73.7	+ 8.7
Design	328	127	38.7	22.7	−16.0	33.3	− 5.4	50.0	+11.3	50.0	+11.3	37.5	− 1.2
Total	1,804	655	36.3	36.0	− 0.2	34.6	− 1.7	33.2	− 3.1	40.6	+ 4.3	37.1	+0.8

position; while in History and Science they are decidedly inferior. The inferiority in English is partially accounted for by the chance grouping in the Autumn Quarter referred to above. An equitable distribution gives the results indicated in the broken line in Diagram 8, showing that there is but a slight inferiority. For the inferiority in Science and History another explanation must be sought. This may be found, in part at least, in the fact that 16 pupils of the University Elementary School omit History and Science and take French and German in their place. A comparison of the standing of these pupils with the 28 others from the school indicates that the work of those not taking History and Science is in general of very much superior grade. Table 5 and Diagram 14 exhibit this fact. This table is exhibited graphically in Diagram 14.

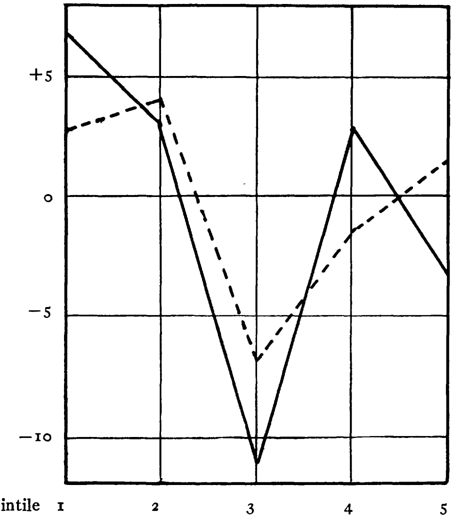

DIAGRAM 8.—Excess and deficiency in grades in English of pupils of Universit Elementary School. (Broken line shows correction in Autumn Quarter.)

The problems which are suggested by this study are numerous. It is not the purpose of this report to enter into detailed discussion of these problems. The paper is offered rather as an exhibition of the kind of study which should in every case accompany supervisory inspection. How one department com-

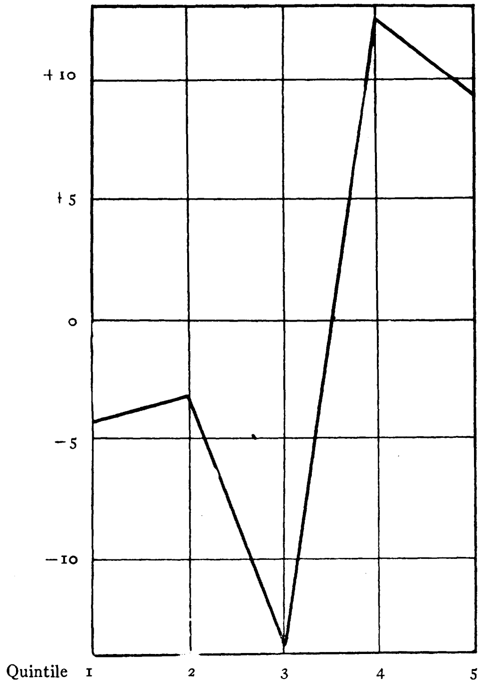

Diagram 9.—Excess and deficiency in grades in Latin of pupils of the University Elementary School.

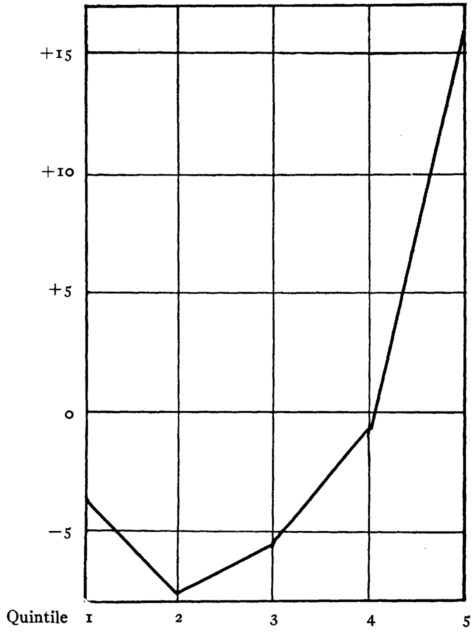

Diagram 10.—Excess and deficiency in grades in Mathematics of pupils of the University Elementary School.

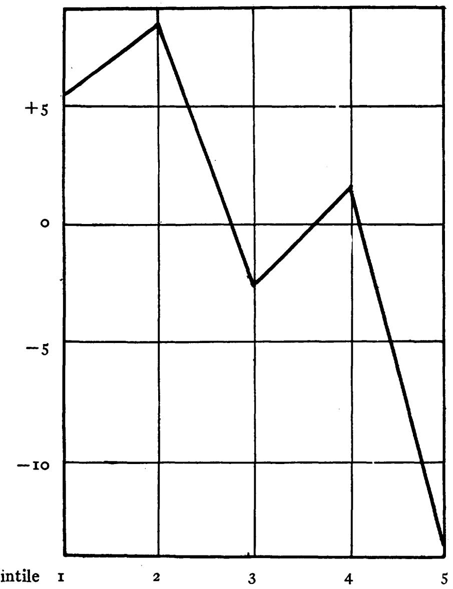

DIAGRAM 11.—Excess and deficiency in grades in Science of pupils of the University Elementary School.

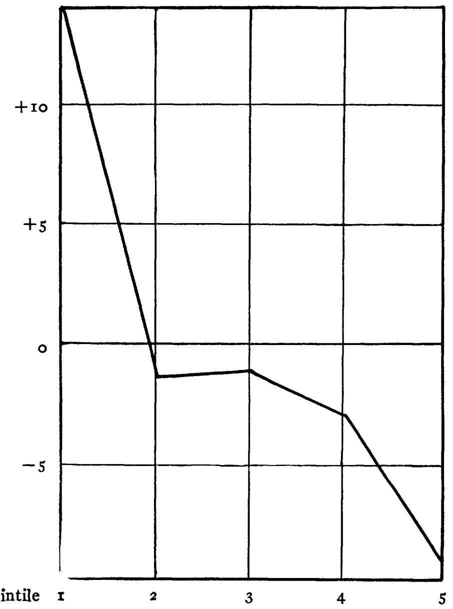

DIAGRAM 12.—Excess and deficiency in grades in History of pupils of the University Elementary School.

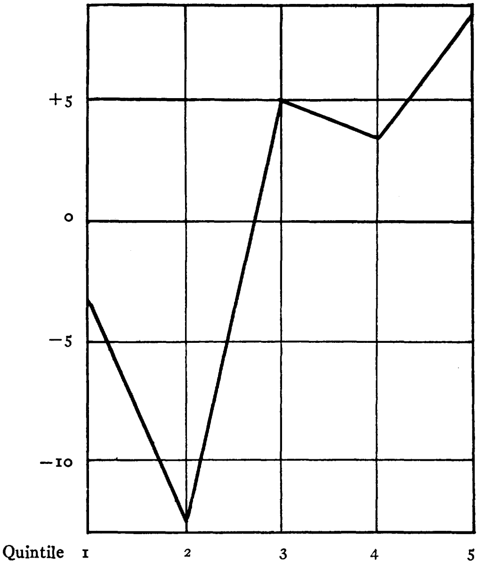

Diagram 13.—Excess and deficiency in grades in French and German of pupils of the University Elementary School.

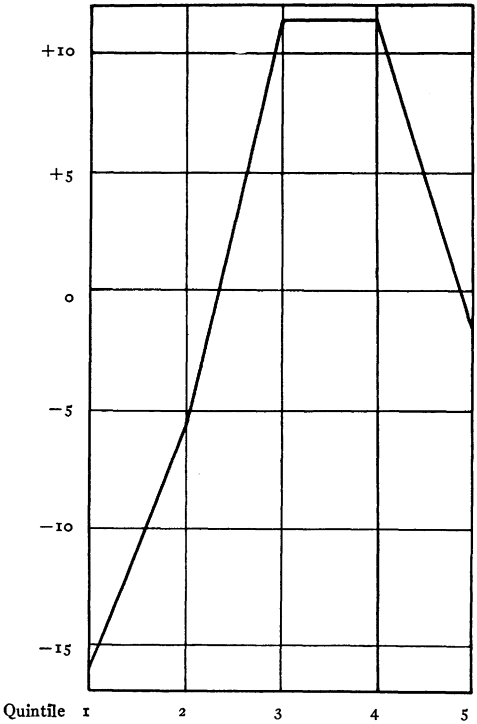

Diagram 14.—Excess and deficiency in grades in Design of pupils of the University Elementary School.

pares with another, how one school compares with another, and ultimately how one teacher compares with another can be discovered by minute and exact comparisons of the products.

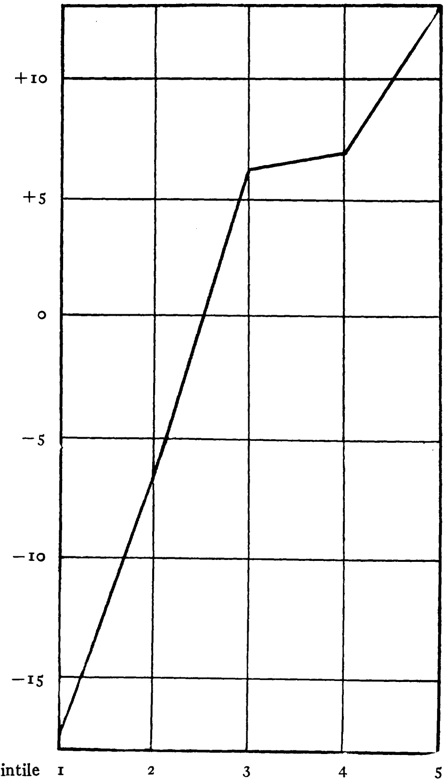

Diagram 15.—Excess and deficiency in grades of pupils from the University Elementary School not taking Science and History compared with grades of other pupils from school.

TABLE V

Comparison of the Grades of the 16 University Elementary School Pupils Not Taking Science and History with Those of the Other 28 from the Same School

Total Number of Grades U. E. S.	Number Grades of 16	Percentage of Grades of 16	1st Quintile		2d Quintile		3d Quintile		4th Quintile		5th Quintile	
			Percentage of 16	Variation	Percentage of 16	Variation	Percentage of 16	Variation	Percentage of 16	Variation	Percentage of 16	Variation
481....	189	39.3	21.8	−17.5	33.0	−6.3	45.4	+6.1	46.2	+6.9	52.2	+12.9